QC meeting update 07.11.2022

Triplet accuracy vs. sub-QUBO size vs. problem size
Artificial QUBO generator

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Measuring QUBO solving performance

Not talking about track reconstruction!

My recommendation: Evaluating the solving success should be measured at the triplet level:

- It's not track reconstruction, but labeling, tagging via an algorithm

- Concluding QUBO solving performance $\rightarrow$ track reconstruction performance, but not the other way round (e.g. track definition)

- Precision, Recall, Accuracy as metrics suitable

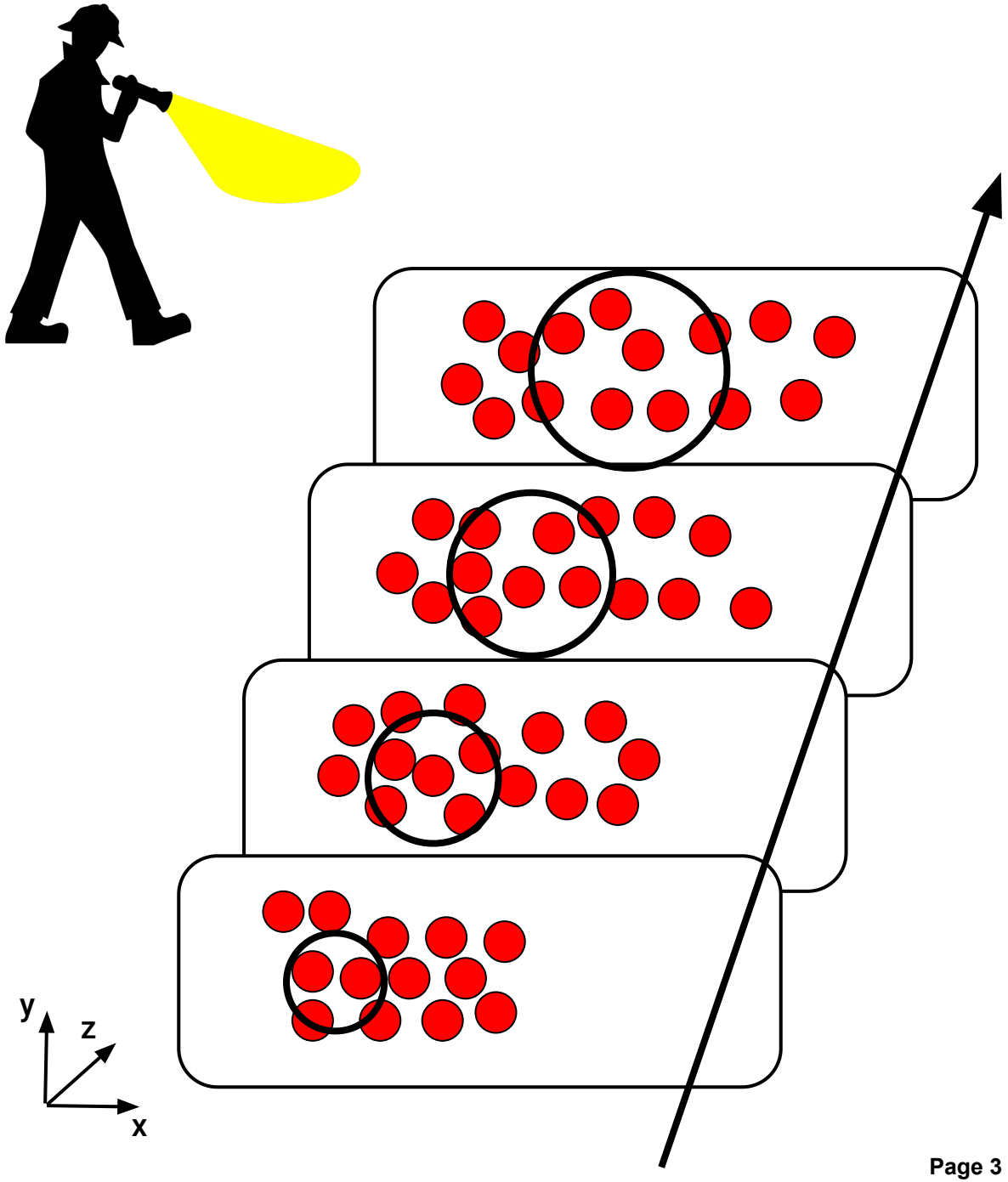
Flashlight on the data

Slice out tracks in cone-like structure from highest density area

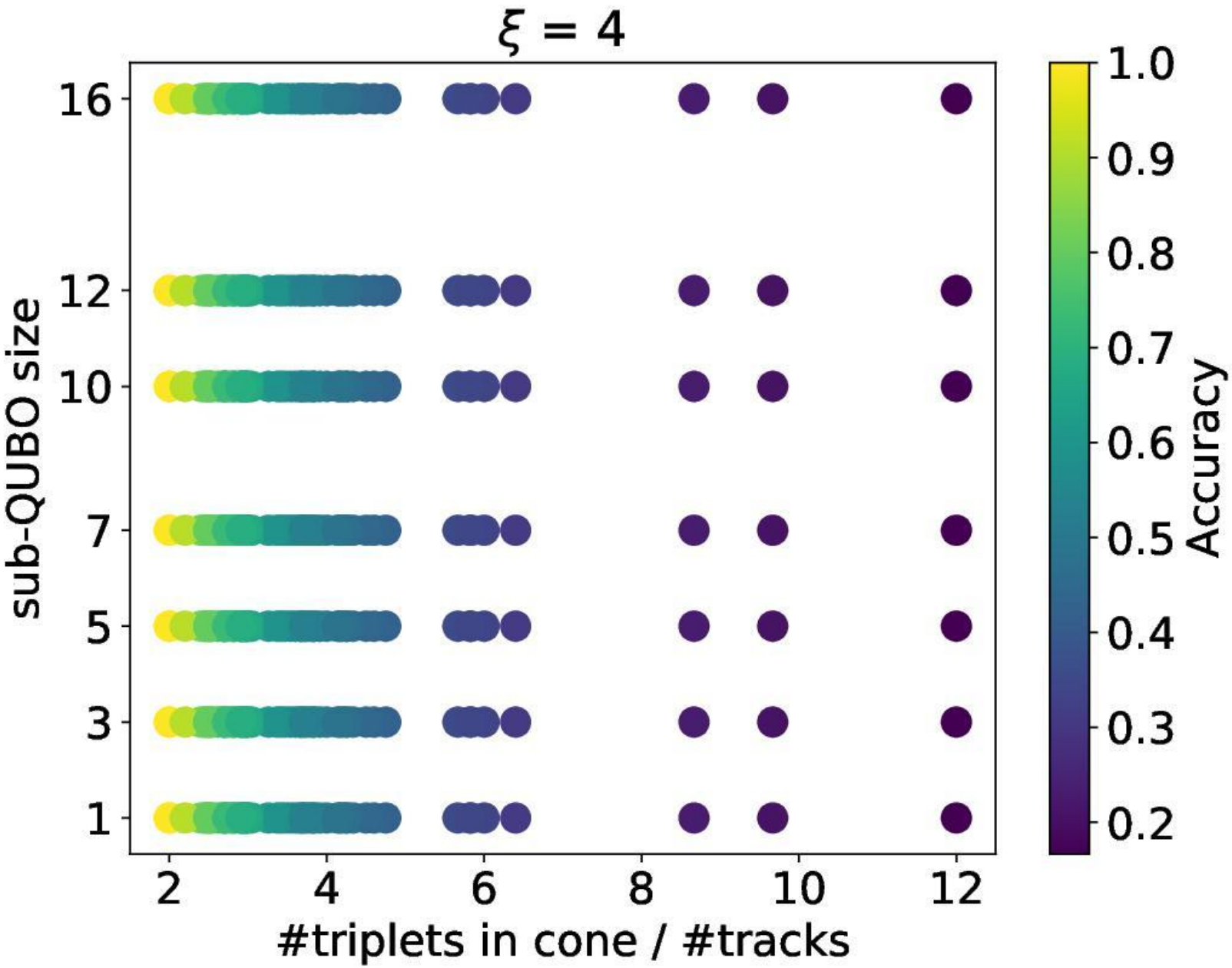
Keep all hits stemming from other tracks just crossing the cone as background

→ probably more difficult (discuss?)

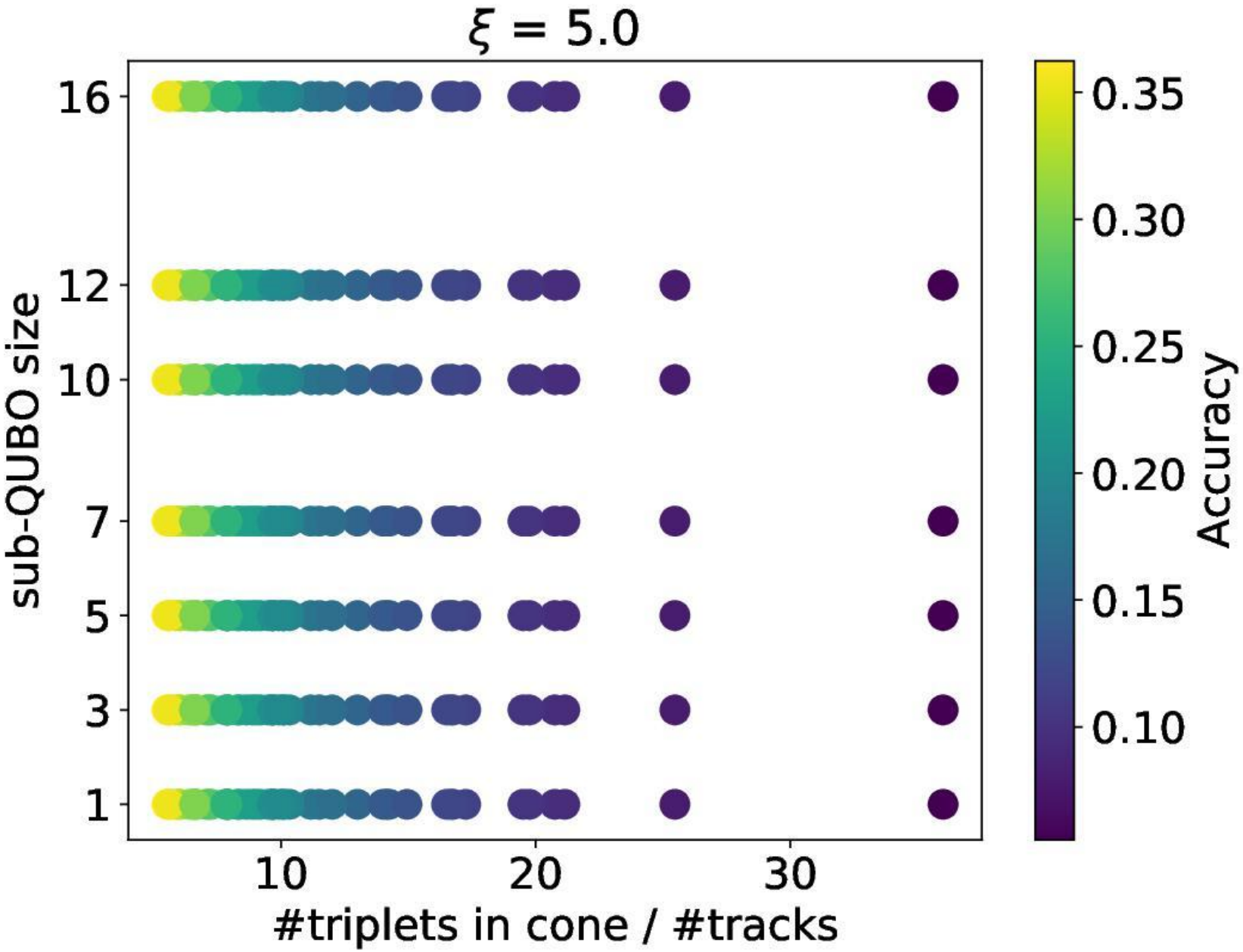
Results average over 10BX for each ξ for various problem sizes → O(10^3) data points for the study



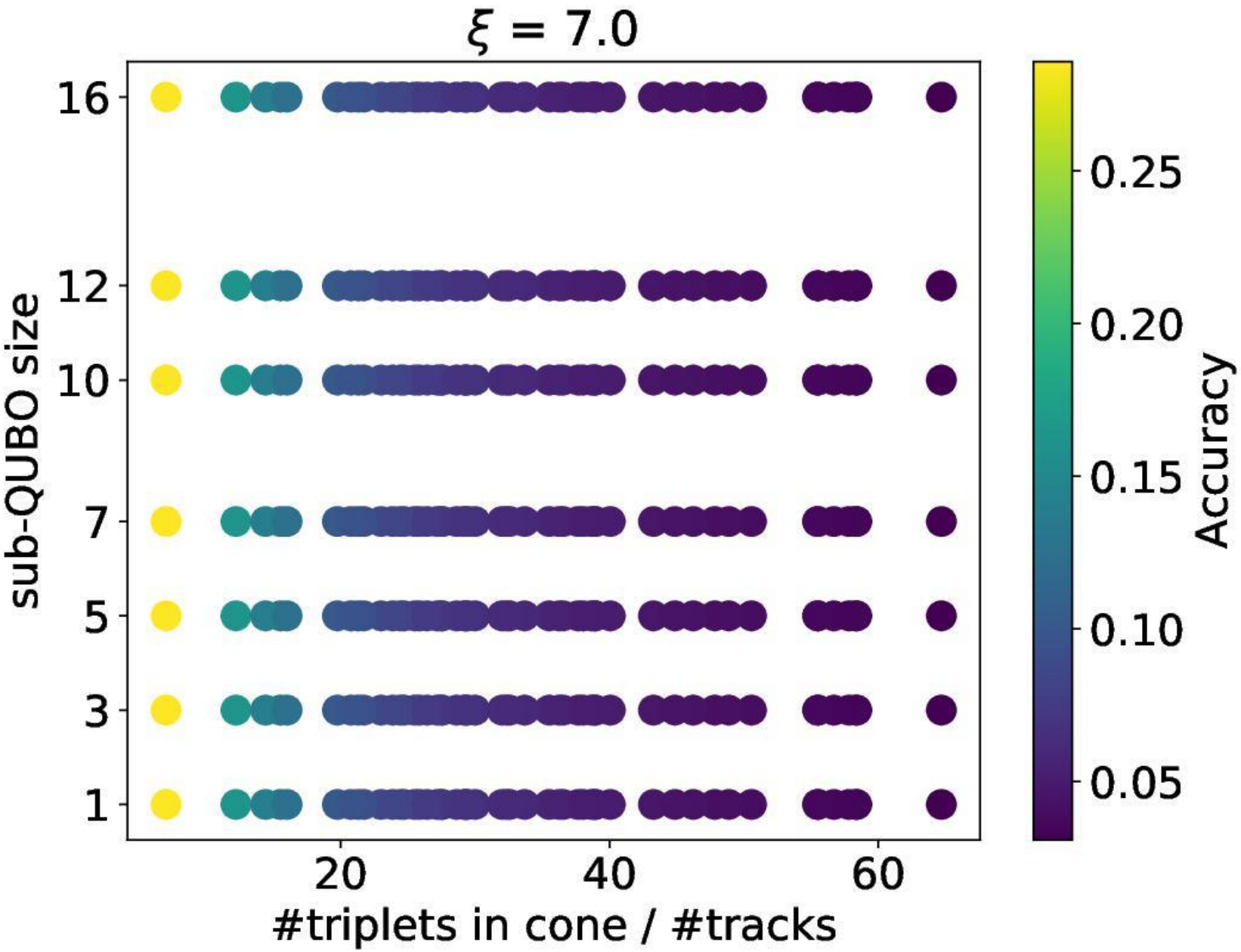
$\xi = 4$


$\xi = 4$
sub-QUBO size
16
12
10
7
5
3
1
2
4
6
8
10
12
#triplets in cone / #tracks
Accuracy
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2

ξ = 5


ξ = 5.0
sub-QUBO size
16
12
10
7
5
3
1
10
20
30
#triplets in cone / #tracks
Accuracy
0.35
0.30
0.25
0.20
0.15
0.10

ξ = 7


ξ = 7.0
16
12
10
7
5
3
1
sub-QUBO size
20
40
60
#triplets in cone / #tracks
0.25
0.20
0.15
0.10
0.05
Accuracy

Artificial QUBO

Tunable parameters:

- # tracks
- # additional combinatorial triplets
- # max additional connections matched triplets
- # max additional connections combinatorial triplets
- # conflicts

Evaluating 10^3 matrices of size 16 x 16

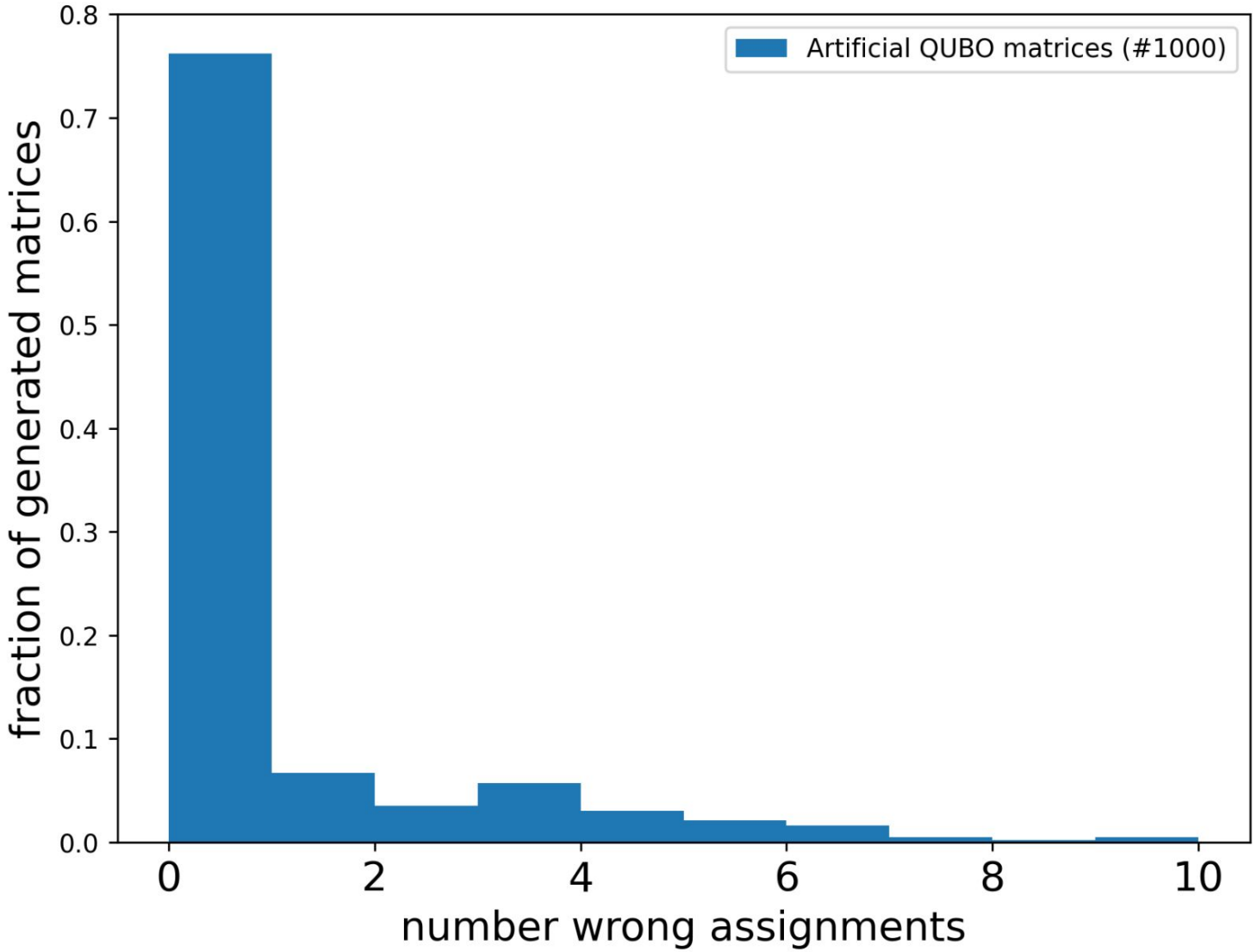
Artificial QUBO Matrix

Structure

$$
\begin{bmatrix}
-0.4594 & -0.9854 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 1.0 & 0.0 & 0.0 & 0.0 \\
-0.9854 & -0.1889 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & -0.9439 & 1.0 & 0.0 & 0.0 \\
0.0 & 0.0 & -0.4474 & -0.9772 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 1.0 & 0.0 \\
0.0 & 0.0 & -0.9772 & -0.1311 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 1.0 & 1.0 \\
0.0 & 0.0 & 0.0 & 0.0 & -0.4901 & -0.9752 & 0.0 & 0.0 & 0.0 & 1.0 & 0.0 & 0.0 \\
0.0 & 0.0 & 0.0 & 0.0 & -0.9752 & -0.2868 & 0.0 & 0.0 & 0.0 & 1.0 & 0.0 & 1.0 \\
0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & -0.2636 & -0.9798 & 0.0 & 0.0 & -0.9462 & 0.0 \\
0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & -0.9798 & -0.281 & 0.0 & 0.0 & 1.0 & 1.0 \\
1.0 & -0.9439 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 0.3203 & 1.0 & 1.0 & 1.0 \\
0.0 & 1.0 & 0.0 & 0.0 & 1.0 & 1.0 & 0.0 & 0.0 & 1.0 & 0.0775 & 1.0 & 1.0 \\
0.0 & 0.0 & 1.0 & 1.0 & 0.0 & 0.0 & -0.9462 & 1.0 & 1.0 & 1.0 & 0.3372 & 1.0 \\
0.0 & 0.0 & 0.0 & 1.0 & 0.0 & 1.0 & 0.0 & 1.0 & 1.0 & 1.0 & 1.0 & 0.3679
\end{bmatrix}
$$

Result for 10^3 QUBO matrices

Artificial QUBO



What’s next?

Remove hits from tracks just crossing the cone and compare results

Fine-tune artificial QUBO and compare results with cone approach